



# **SNS PLC Architecture Standards**

- I. BNL PLC Lab
- II. BNL PLC Plan
- III. ControlNet & Ethernet

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# I. SNS PLC Lab - Objectives

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## Objectives of the PLC Lab

- To standardize on a limited number of PLC manufactures and models
- To reduce effort to develop EPICS software drivers
- To reduce operation effort to support multiple PLC models
- To obtain the best pricing by pooling of orders
- To concentrate efforts to develop best practices

## I. SNS PLC Lab - BNL effort



### PLC Architecture Standards R/D Conducted at BNL

- Evaluated three Allen-Bradley's PLC models
- Studied the possibility of using Ethernet to link IOC and PLC for real-time control
- Implemented a prototype system of using ControlNet to link IOC and PLC or remote I/O modules, such as Flex I/O or A-B 1771 I/O modules
- Tested IP-DeviceNet module
- Compared VME RS485 link vs PLC RS485 link

## I. SNS PLC Lab - BNL effort - AB PLCs

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Three Allen-Bradley's PLC models have been evaluated

- We choose A-B PLCs because A-B PLCs are the most popular models that have been used in existing projects at the five SNS collaborating labs
- Although ControlLogix is the most advanced PLC model among the A-B three PLC models and it is even less expensive than PLC-5 model, we experienced difficulties of pushing ControlLogix as a standard model. BNL engineers have the most expertise on PLC-5 models.

# I. SNS PLC Lab - BNL effort - Ethernet link



## Link IOC and PLC over Ethernet for real-time control

For IOC to perform a real-time task over Ethernet to communicate with PLC or remote I/O devices, we need two things:

- ❶ The plant network has to be configured in a “star” topology with Ethernet hubs & switches to avoid collisions and entitle its deterministic label
- ❷ Ethernet provides only physical and data-link layer protocol. We need obtain the upper layer information to be able to implement an EPICS driver to communicate with PLC - we experienced the difficulty to get A-B PLC Ethernet client protocol from Allen-Bradley

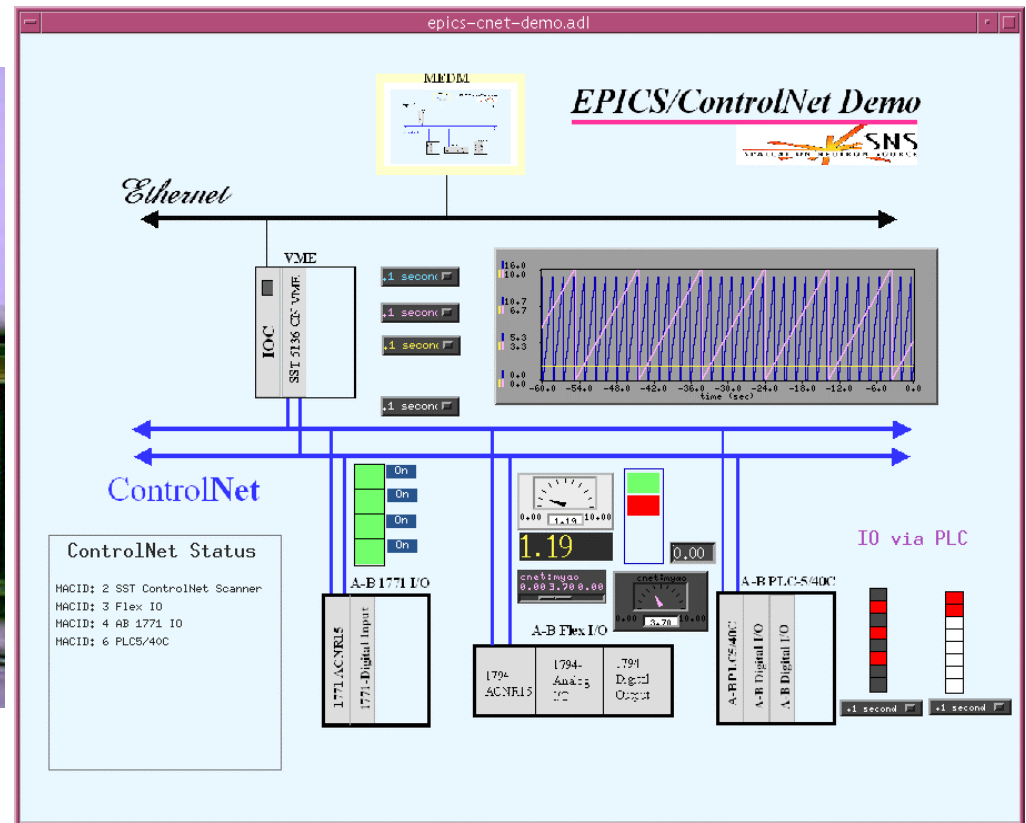
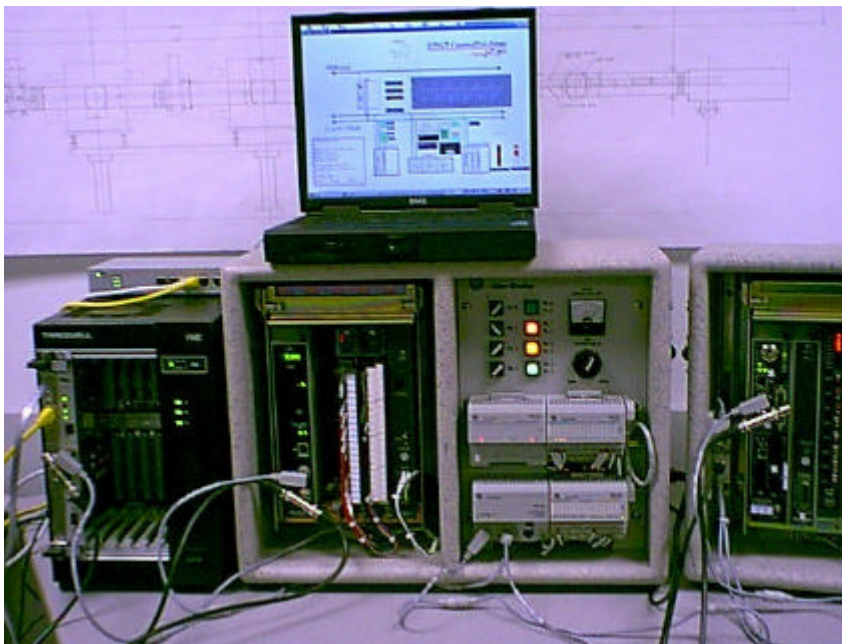
**Good News** -- A-B is opening its PLC Ethernet application layer protocol --- Control and Information Protocol (CIP)

Real-Time control over Ethernet is innovative, but it will be a future control network while Ethernet will begin to approach the guaranteed delivery and reliability of powered switches or hubs is improving.

# I. SNS PLC Lab - BNL effort - ControlNet



## EPICS/ControlNet Prototype System



**SNS Controls** - April 18, 2000 Oak Ridge

## I. SNS PLC Lab - BNL effort - DeviceNet

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### IP-DeviceNet Module Evaluated by David Lui

- Huron DeviceNet Starter Kit was used
- Tested VME/IP-DeviceNet as slave
- Unfinished with VME/IP-DeviceNet as master due to lack of tools to update IP-DeviceNet module firmware
- Planned to test SST VME DeviceNet module

## I. SNS PLC Lab - BNL effort - RS485 link

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Three types of RS485 link modules are under evaluation

- GS VME/IP-485 module
- ProSoft MVI94 Flex I/O Module
- 1756-MVI module for ControlLogix (Online Development Inc)



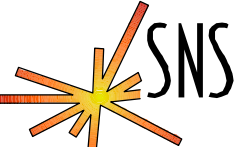
## II. BNL PLC Plan

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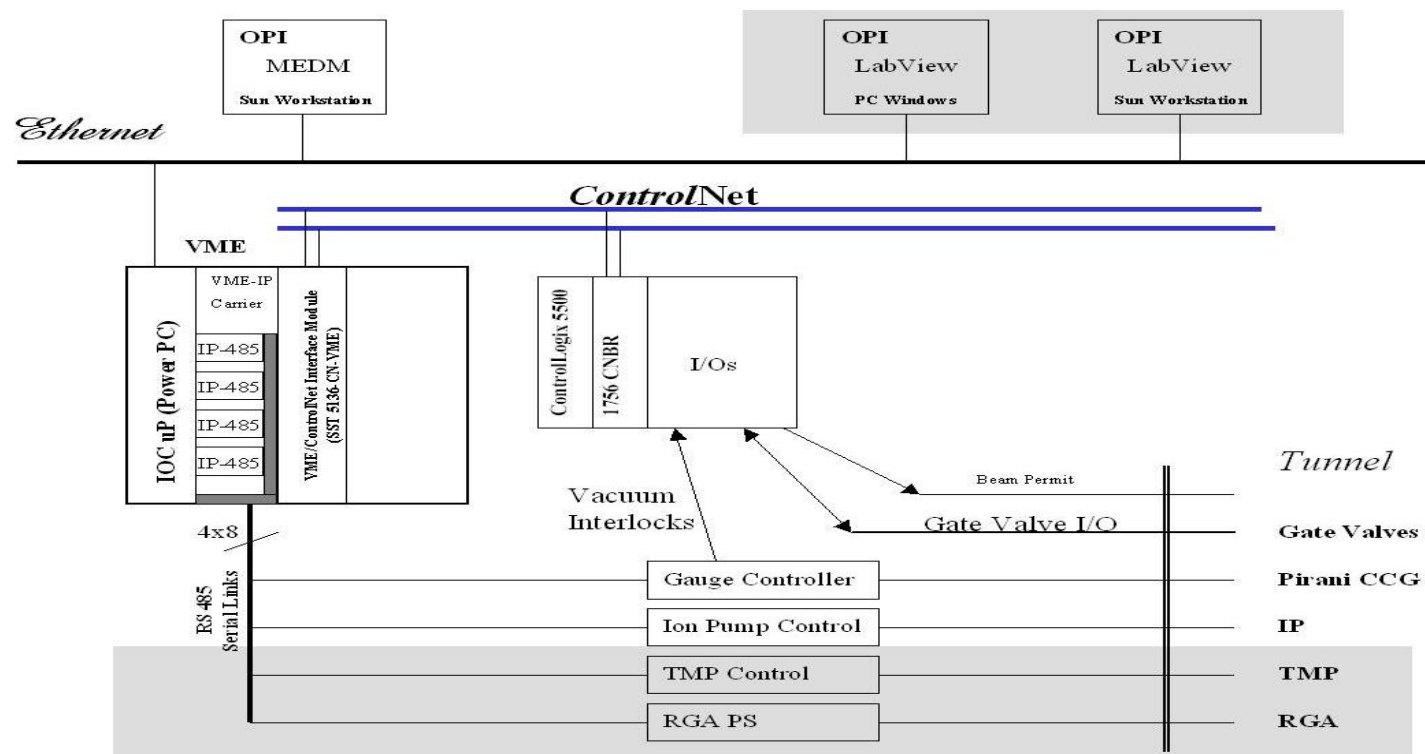


- Plan for SNS Ring Vacuum Instrumentation Control
- Plan for SNS Ring RF Control Interface
- Plan for EPICS ControlNet Support Development

## II. BNL PLC Plan - Vacuum Control



*A Vacuum Instrumentation Interface Prototype Control System is planned to be implemented*



## II. BNL PLC Plan - *EPICS/CNET Support*

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### *Plan for ControlNet EPICS Support*

- Document and release alpha version of ControlNet EPICS Support
- Add mapping feature so that val, rval, alarm limit can be mapped to one record
- Add one layer so that applications with 6008 RIO can be replace to with SST vme-cn module
- Port existing A-B I/O device support to ControlNet
- Implement EPICS ControlNet configuration tools

### III. ControlNet - *Advantages and disadvantages*

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**ControlNet** is a real-time, deterministic control-layer network providing for high speed transport of both real-time I/O and messaging data on a single physical media link

- Passive Media Components vs. powered switches or hubs

*loss of any one node will not result in a network failure*

- Media Redundancy

*ControlNet offers physical media redundancy as a standard option*

- Determinism

*by having bandwidth that can be scheduled, data on controlNet is guaranteed to arrive at specified intervals regardless of the number of nodes on the network*

Although there are 57 companies as ControlNet members to develop ControlNet products for interoperability, there are only one VME/ControlNet module available by SST